New Spinning Technologies
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Lecture - 09
Spinning Tension

So, today we are going to discuss Spinning Tension.

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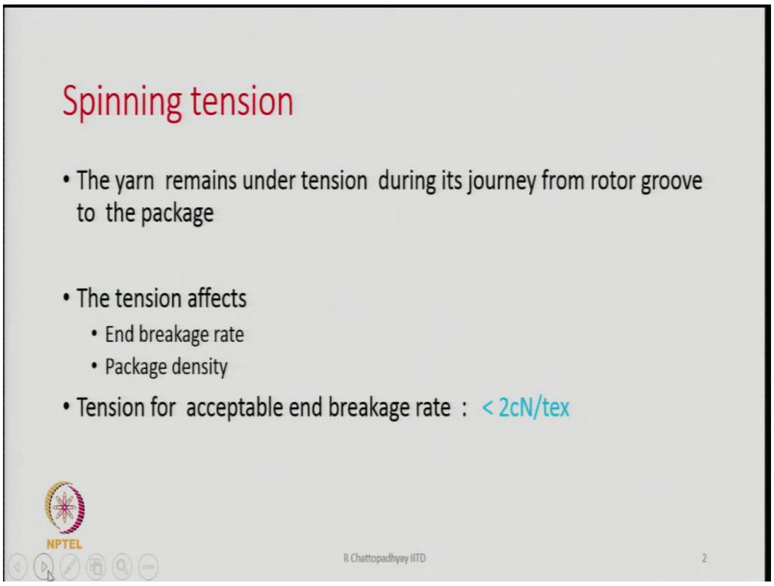

The yarn remains under tension during it is journey from the rotor groove to the package and the tension develops because of the speed with which the yarn rotates within the rotor. The tension affects end breakage rate with how frequently the yarn is going to break during spinning operation depends upon the magnitude of tension that develops while we are spinning the yarn.

The other important fact about the effect of spinning tension is the package density, that is density of the final package which could be either most probably most of the time it is cheese or it could be cone also. So, what is the package density? That also depends upon the tension in the yarn, while the yarn is traveling from the rotor groove to the to it is destination that is the package.

Now, end breakage rate obviously will affect the productivity and every breakage has to be replaced by a joint through splicing operation and therefore a splice is a will may sometime lead to a kind of fault in the yarn, because it will never be exactly like the normal yarn. And hence too many breakages means too many splice joints and the splice joints could be a source of fault in the yarn in some cases.

So, nowadays the splicing technique has improved a lot and most of the splice joints are so good in look, that most of the time will not be able to really make out whether it is a joint portion of the yarn or it is a normal part of the yarn. The tension which is acceptable from the point of view of end breakage rate has to be < 2 cN/tex; that means, depending upon the type of the count of the yarn that I produce.

So, it will produce a yarn of let us say 40 tex in that case the tension level has to be less than 80 cN and 1 cN is close to 1 gram it has to be less than 80 gram. So, that we do not encounter too many breaks, this is general guidelines.

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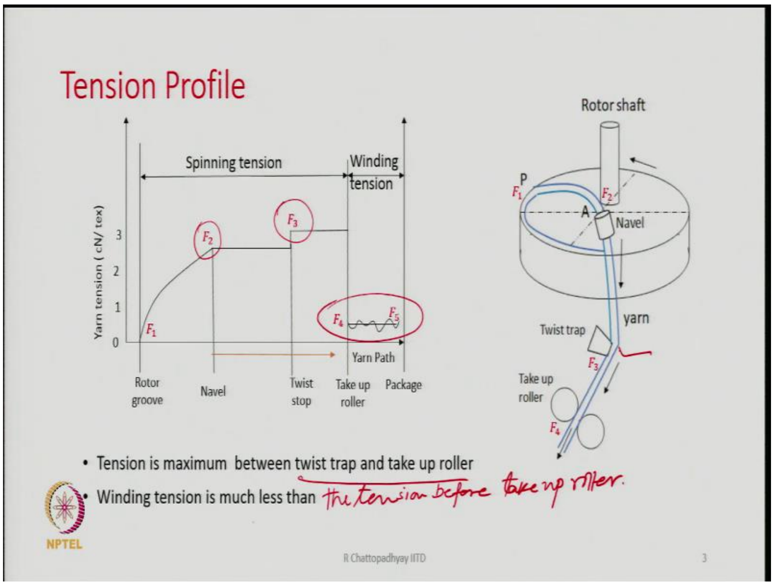

The tension profile if we see which is shown here that is starting from the rotor groove to the package, the tension in different part of the yarn along it is path are not exactly same they are different. So, the way the tension is changing from the rotor groove to the package is depicted here and you can see that winding tension and the spinning tension, winding tension is fairly constant.

Whereas, spinning tension changes starting from almost 0 at the rotor groove then it goes up to a level ‘F_1’ to ‘F_2’ then at the level; obviously, it takes a bend it takes almost a 90°

turn and then moves towards the take up roller. In between we can have a twist stop and the twist stop also there is could be a slight jump in the tension level it can go from 'F_2' to 'F_3' the twist stop is shown here.

And then from 'F_3' as it goes to the go to beyond the take up roller here there is a sudden drop in tension and between the take up roller and the package, the tension remains fairly constant which is close to 'F_r' as has been depicted here. So, 'F_r' and 'F_5' 'F_5', 'F_4' sorry not 'F_r'. 'F_4' and 'F_5' are practically same.

So, this is how the tension in the yarn is rising from almost 0 and the rotor groove to a level in two steps and then the tension falls depending upon the speed of the take up roller. And then beyond the take up roller the tension really falls a lot and because we adjust the speed of the take up roller and the package in such a way that the tension they are this part or on this zone reduces and at the certain level of tension we keep winding the yarn. So, this is the picture.

So, tension is maximum between twist trap and take up roller and winding tension is generally much less than their tension that you see before it arrives in the winding zone. So, winding tension is much less than the tension before take up roller. Now this is the picture of the tension and obviously we have to see that what is the role of this tension on end breakage will come to that gradually.

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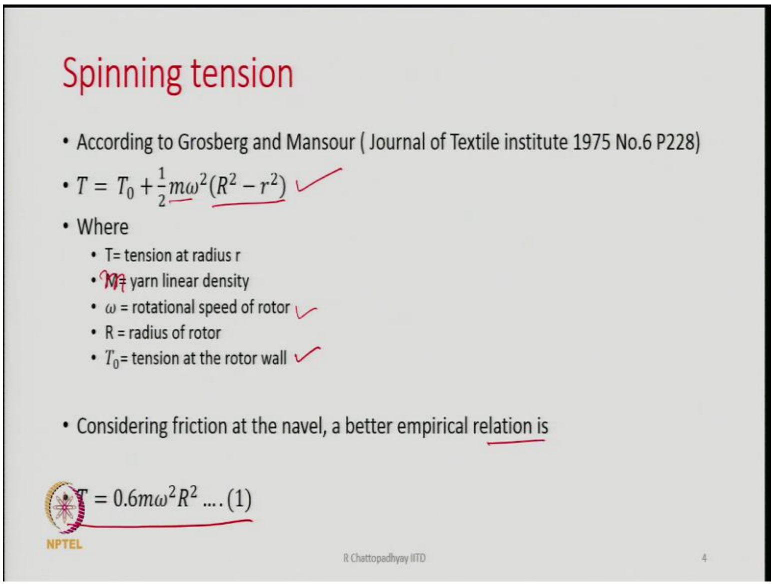

Now, spinning tension has been theoretically modelled by some researchers. So, in one of these work done by a Grosberg and Mansour; we see this equation which says that the tension at radius '*R*' in the rotor groove the yarn R may exist and at any point on the yarn R which could be a distance of small '*r*' from the rotor groove, the tension is

$$T = T_0 + \frac{1}{2}m\omega^2(R^2 - r^2)$$

So, '*R*' is the radius of the rotor, 'ω' is the rotational speed of rotor, '*m*' is the '*m*' is the yarn linear density and 'T_0' is the tension at the rotor wall. So, this relationship has been shown, but considering the friction at the navel a better empirical relationship is this one. That is,

$$T = 0.6m\omega^2r^2$$

'T_0' usually is very small, so sometimes people have neglected also while they are trying to estimate the tension in the yarn.

But at the same time as the yarn is moving from the rotor, so the yarn comes into contact with some metallic surfaces and the trumpet or the navel is one of them. So, whenever the yarn is also not only yarn is rotating the yarn on within the rotor is turning at a very high speed, at the same time there is a movement of the yarn along it is own axis towards the package.

So, the yarn is in contact with the trumpet of the rotor or the navel of the rotor and this is in contact and there is certain amount of pressure which is acting on it and it is also being withdrawn. So, there is some friction which is happening over there and the friction resistance also will add up to the tension and therefore, it has been shown by some people that a better empirical relationship could be, '$T = 0.6m\omega^2R^2$'.

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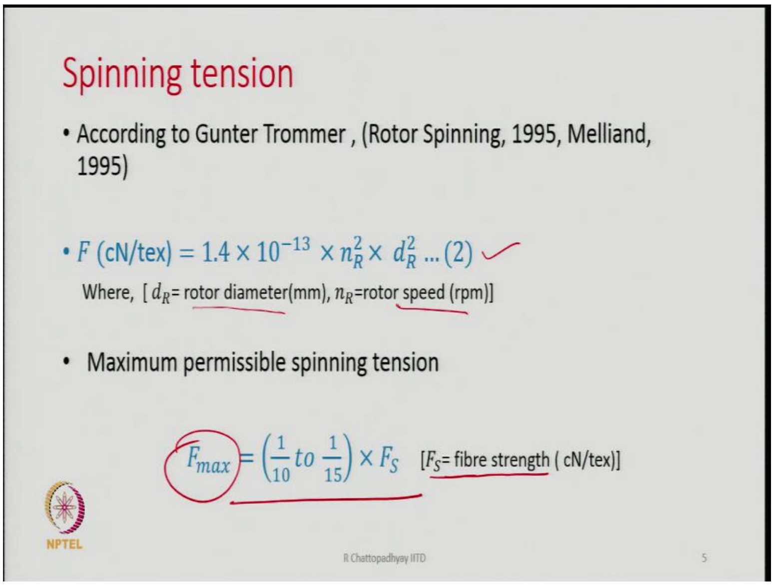

According to Gunter Trommer in a book which is Rotor Spinning published by Melliand, it has been shown that the spinning tension has been shown to be,

$$F(\text{cN/tex}) = 1.4 \times 10^{-13} \times n_R^2 \times d_R^2$$

Where, what is 'n_R' and 'd_R' are stated here? 'n_R' is the rotor speed in rpm and 'd_R' is the rotor diameter in mm.

Generally, we you know we express the rotor diameter in mm and the speeds or rotor speed generation is expressed in terms of rpm. So now, considering the usual units which are practiced or used in the industry this equation has been stated. So, you can get an idea of this equation or so the idea of the tension following these equations.

The maximum permissible spinning tension because we have to avoid too many breakages, we have to see that, we cannot run the machine at a very high speed if my fibres are weak in nature. So, the maximum permissible tension has to be a function of strength, intrinsic strength of the fibre 'F_S' and F maximum,

$$F_{max} = \left(\frac{1}{10} to \frac{1}{15}\right) \times F_s$$

Such kind this is the maximum tension which can be used in order to make sure that we do not encounter too many breaks too many end breaks. So, we can get some idea that if the my fibre is not really very strong we will not be able to run the rotor at a very high speed, because tension will be too much and there will be too much of end breakage. That means, how much rotor speed will be attainable will depend upon the quality of the fibre that we are using ok.

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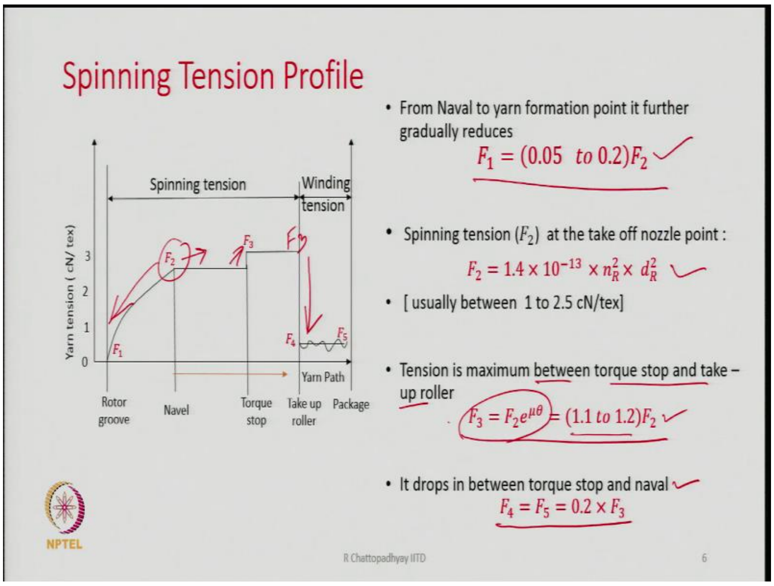

Now, from here we come back to the tension profile and the tension at different zones can be shown by this set of equations, from naval to yarn formation point reduces to this value,

$$F_1 = (0.05\ to\ 0.2)F_2$$

So, in this zone 'F_1' with respect to 'F_2' there is a reduction and how much is the reduction? Which is around '(0.05 to 0.02)F_2'.

So, if we and it becomes this spinning tension at the take-off nozzle point. That means, it is here in this zone take up nozzle that is basically the navel or trumpet. See in different books or in different research papers you will find is written sometimes in trumpet sometimes navel, sometimes take up nozzles.

But all meaning basically is the same element which is placed at the centre of the rotor and the yarn takes a bend and then it moves out from this take up nozzle or say or trumpet or navel whatever we say. So, 'F_2' is the value of this tension here after the navel. So, it is taking care of the friction the yarn friction resistance the yarn actually experiences while it is crossing the navel and there is a bend over there.

Then tension is maximum between Torque stop and Take up roller here, then there is a another jump in tension and what is the 'F_3' value? 'F_3' value is this much that is,

$$F_3 = F_2 e^{\mu\theta}$$

Because the torque stop or the twist trap sometimes it is called torque stop or you may also find that people are here saying this is as twist trap.

The yarn is made to pass over it and it comes into contact with it the yarn is deflected a bit, because of the deflection there will be a change in tension. So, we all know the Amontons law; the Amontons law is used to find out the tension after the twist trap or torque stop.

So, before and after the values can be modelled by using this Amontons law and this has been shown to be '(1.1 to 1.2)F_2' depending upon the actually the deflection angle or the angle of contact between the yarn and this torque stop. After that it drops after torque stop and or twist trap this is the value 'F_4', 'F_5' is only 0.2 times 'F_3'.

So, whatever is 'F_3'? 'F_3' is here and there is a certain drop of tension here. So, between 'F_4' and 'F_5' the tension level is only 0.2 times what was at the 'F_3' level. So, this is how so that means actual winding tension is much less than the tension in the yarn that exists between the torque stop and the take up roller.

So, this has to be now understood that the maximum tension is not really in between the take up roller and the package that is in the winding zone if tension is not really maximum. Tension is maximum prior to the winding zone. So, even the winding tension may be normal, but still, we may encounter too many breaks, because the winding tension may be close to normal still the that the tension of the other zones may be quite high because of not maintaining the you know parameters at the right level.

The friction may coefficient of friction may change because of the wear and tear of the parts with which the yarn is coming into contact and therefore you know the tension value you know prior to this take up roller may be quite high, because maybe the never less bit damaged or the torque stop is also bit damaged.

So, when the yarn is passing about it at a very high speed and there is a pressure there are a lot of friction lot of abrasion lot of wear and tear will be there and as a result the with time there will be change in frictional coefficient and therefore frictional resistance and hence tension may change also.

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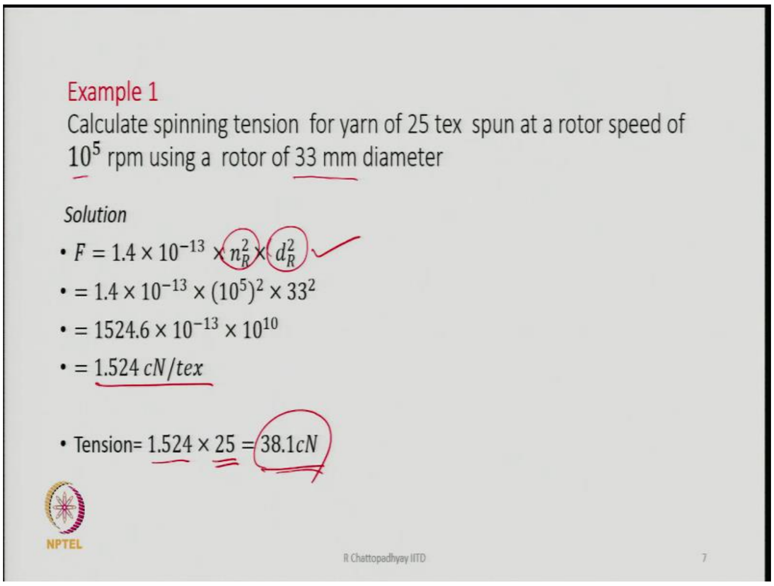

Now we will have taken example of tension calculations calculate spinning tension of yarn of 25 tex spun at a rotor speed of 10^5 rpm using a rotor of 33 mm diameter. How much tension will develop in a yarn of 25 tex? When the rotor speed is almost 100000 rpm a rotor diameter is 33 mm. So, you need to know what is the tension?

So, straight way we use this equation,

$$F = 1.4 \times 10^{-13} \times n_R^2 \times d_R^2$$

We have to be careful about the units and if we substitute the values here, then we can find out what is the tension in a cN/tex first. So, we put the values of rotor speed and rotor diameter and by doing so, we get a figure which is 1.524 cN/tex. So, that is the tension in per tex.

So, tension in the yarn we have to multiply by the yarn tex. So, by multiplying by the yarn tex, we get the tension value 38.1 cN and as it was shown earlier that the permissible tension level should be less than 2 cN/tex. And for 25 tex yarn that means, my maximal tension can be at the most 25 into 250 cN. So, it should be always less than 50 cN and here we are getting a figure 38.1.

So, we can hope or we hope that at a such a speed and with this diameter we will be able to spin the yarn, because the tension that will develop, we expect it to be still less than the permissible tension to avoid too many of end breaks and this is how we can. So, the calculation part is simple.

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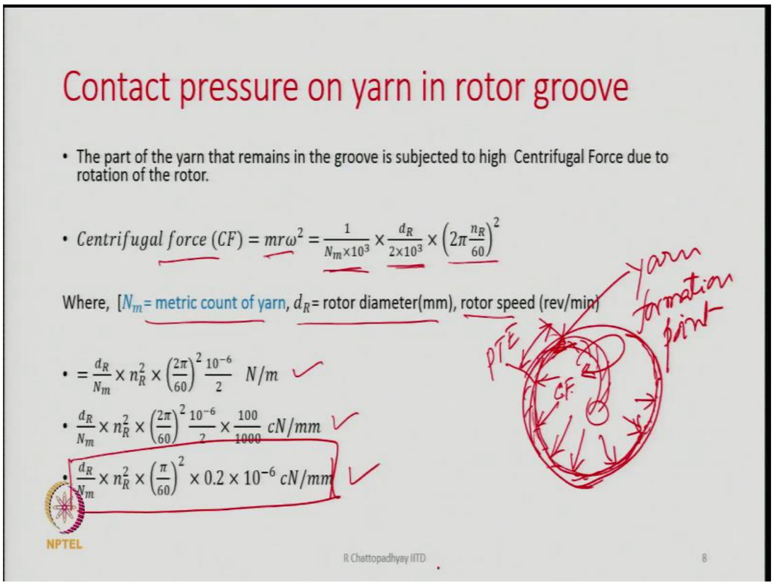

The other thing we may sometime need to know is the contact pressure on yarn in the rotor groove, within the rotor you have a band of fibres which are continually getting deposited and part of the band of fibres is also twisted not the entire band. So, if this is the we have discussed it earlier if this is the band of fibres here to here this zone is called PTE zone and this band of fibres is here gradually the thickness of a band will reduce.

So, this band of fibres is experiencing lot of centrifugal force it is resting in the groove and the rotor is turning at high speed. Therefore, lot of centrifugal force is acting on this band and therefore and we have to here the twist has to flow into this band and as I said the PTE zone that is peripheral twist exchange zone has to be of certain you know certain length; that it cannot should not be 0 neither it should be too long.

So, if the pressure why we need to know if the pressure is too much the torque the yarn is rotating on it is own axis, this torque may not be able to flow into the band of fibres. Because the band is resting against the rotor wall and that too in a place which is looks like a conical in nature and there then if we want to drive the torque, we have to overcome the frictional resistance against the rotor wall and frictional resistance is a function of normal force.

So, normal force, centrifugal force is the source of normal force on the band of fibres. So, how much the centrifugal force is '$mr\omega^2$', very standard formula and if 'N' is the metric count of yarn 'd_R' is the rotor diameter and rotor speed then 'm' value is this if we express the yarn count in metric.

Then this is the rotor diameter, '$d_R/2$' is the rotor radius and 10^3 is expressing the radius in terms of meter and then here is the rotor speed 'ω', 'ω' is the angular speed. So, rotational speed has to be changed into 'ω' value. 'n' has to be changed to 'ω'.

So, if you do that these are the steps shown one after the other, so that it is easy for you to understand after writing the value of 'm', 'r' and 'ω' then we are trying to simplify gradually and we arrive at this figure this equations.

$$\frac{d_R}{N_m} \times n_R^2 \times \left(\frac{2\pi}{60}\right)^2 \frac{10^{-6}}{2} N/m$$

So, much cN/mm that is the per millimeter so much centrifugal force is actually, so much pressure is working pressure is in terms of force per unit length not really force per unit area.

It is how much force is acting per unit length of the band of fibres which is there in the PTE zone. Now, here we have what we have done this band of fibre close to the yarn formation point has been assumed to be equal to the yarn count, as we know that the band becomes thinner and thinner.

So, as we go away from the PTE zone actual mass of the fibre is less and less, so but close to the yarn formation point that this is the yarn formation point, the yarn mass and the fibre mass is practically same. And therefore, we can we are replacing it by the yarn mass has been replaced therefore the fibre mass so it will be replaced by the yarn mass.

So, from the yarn count we can find out what is the weight of yarn per millimeter or per meter as the you know it depending upon what are the units you are choosing and we can find it out and accordingly we can say this is the value that we will get and if I want to use the text count then also, we can do it. So, the these are the same equations.

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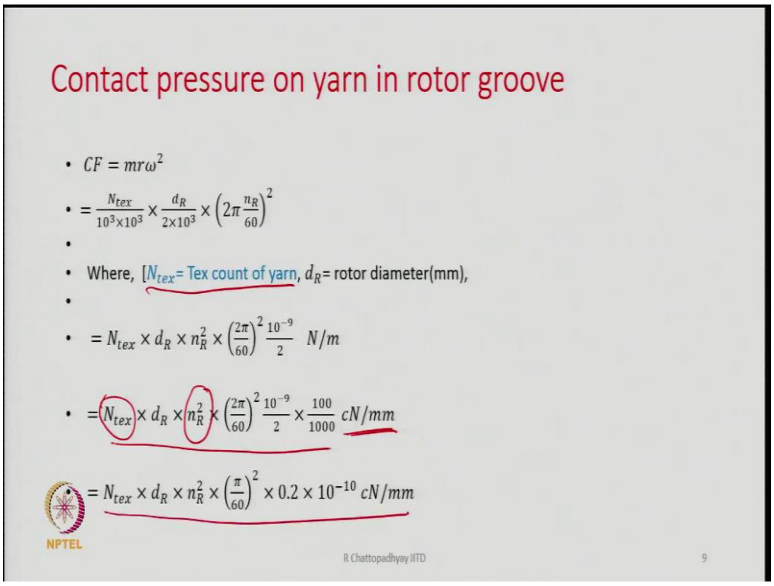

Now the yarn count has been chosen in terms of tex and we have also can find out what is the final equation the unit is cN/mm. So, contact pressure or contact force in the rotor groove can be worked out. So, what we see here that what really is important that affects the contact force, the most important factor is this that is the speed of the rotor.

So, the rotor is larger contact force will increase linearly with the diameter of the rotor. So, bigger rotor means more force on the band of fibres, smaller rotor means in a way less force. But at the same time, we have to see, what is the rotor speed? With the rise in rotor speed the contact pressure will rise very fast because it is proportional to square of rotor speed and the contact pressure is directly proportional to the count of the yarn.

So, if the yarn count is heavy that is if I going for coarser counts the contact pressure will be more because fibre mass is more. If we go to bigger diameter rotor under identical conditions contact pressure will be more and if we go for higher rotor speeds then contact pressure will increase very fast. So, many a times what we do that we keep the surface speed of the rotor constant and go for a combination.

So, that we use small rotor and run them at higher speed or we use bigger diameter rotor run them at a slower speed. So, the surface speed remains same sometimes it has been found that a combination of diameter and speed that gives you best spinning stability, should be preserved. So, that if you want to change the rotor diameter either you increase or decrease the speed accordingly.

So that the surface speed remains practically same and you hope that by doing. So, you will be able to spin the yarn successfully the stability will improve, so that you will not encounter too many breaks. So, anyway so these are the different aspect that we learn from here.

So, the pressure itself is also important because too much of pressure will not allow the twist to penetrate into the groove and there because of this also it can lead to end breakage. Because the fibre band in the groove are not getting twisted, because the torque is not in the position to reach the groove. Next this is the final equations.

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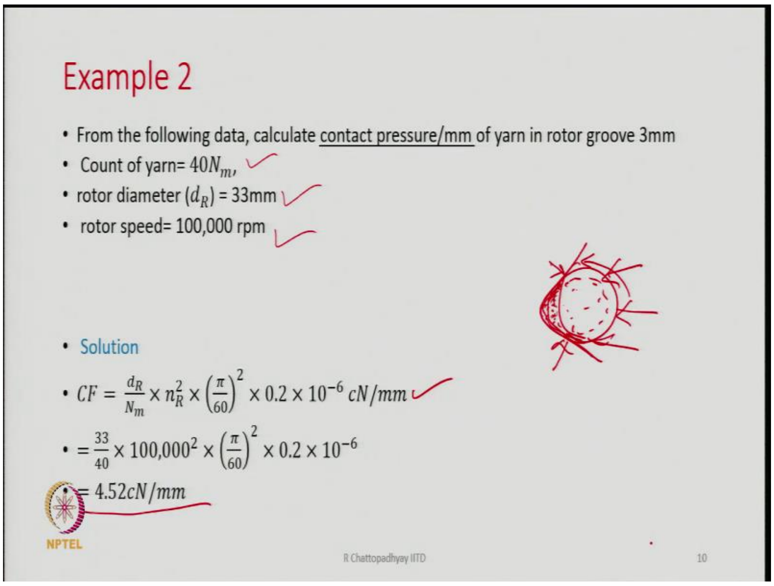

Another example to find out the contact pressure, from the following data I calculate contact pressure. So, these are basically state forward substitution base. But one should only be careful about the units, because units sometimes will be given in the we will give it to different units in order to know whether you really can change the units from one unit to the other, the conversion factors this would be clear in your mind.

So, the from the formula which we already know we straight way substitute the values of count of yarn, the diameter and the rotor speed and we get a idea that how much force is acting per millimeter of the milli meter of fibre which is there in the rotor groove. Typically, it is 4.52 cN/mm.

So, the PTE zone let us say is 10 mm. So, that 10 mm band of fibre will be experiencing 10 into 40, '10×4.5' almost 45 cN of force will be acting on this band of fibres and accordingly the friction will develop. Because ultimately the yarn that exists in the groove the band of fibre, it has to rotate and these are the friction points.

The yarn may not be circular at this point when the fibres are not really twisted it may be flattened and it will go like a shape like this and if it is taking a shape like this. Obviously, the lot of force which is acting centrifugal force, lot of friction will be there and it one has to overcome that friction.

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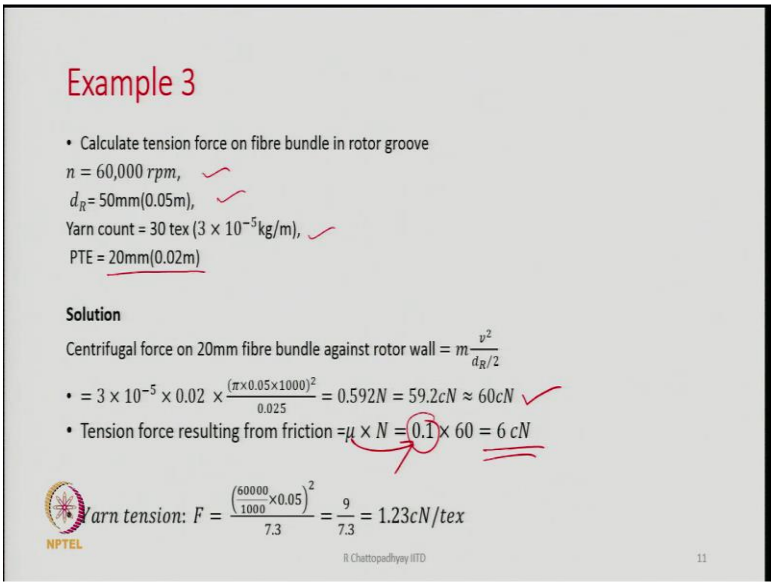

The torque should be sufficient enough to overcome this friction and twist the band of fibres. This is this problem is not there in the case of ring spinning. Another example is calculate tension force on the bundle of fibre in the rotor groove from the following data. The data is speed is given, diameter is given, count is given, and PTE zone 20 mm is given.

So, we are trying to find out how much tension is there, this is centrifugal force; tension force resulting from friction is 6 cN. The 'μ' value has to be given so the value of 'μ' is 0.1.

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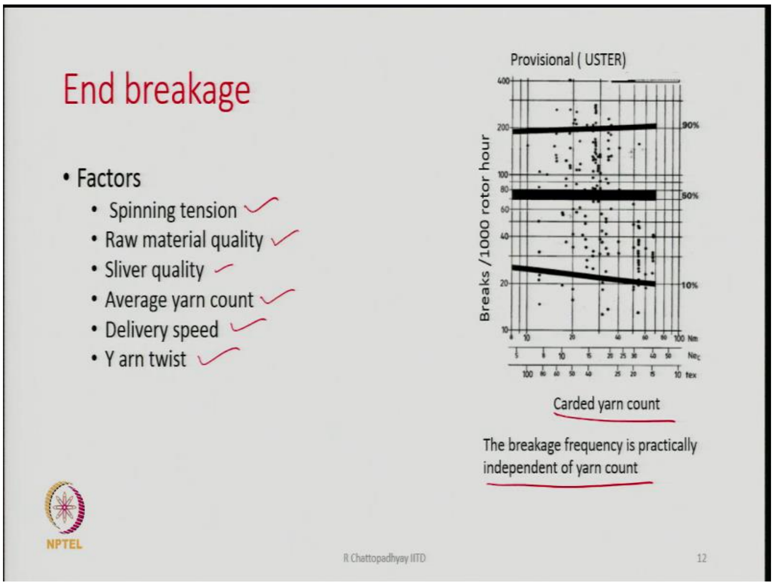

Now we go to the end breakage on the right hand side the provisional USTER data is given relation to the breaks per 1000 rotor hour for carded yarn count. And what we see here that the breakage frequency is practical independent of the yarn count in the case of rotor spinning. That is as the count becoming finer or coarser the breakage rate really does not change, really does not change that is the USTER statistics.

Now, the end breakage rate the factors which affected first of all the spinning tension, makes a raw material quality, sliver quality, average yarn count, delivery speed and yarn twist; these are the many factors that can affect the end breakage rate.

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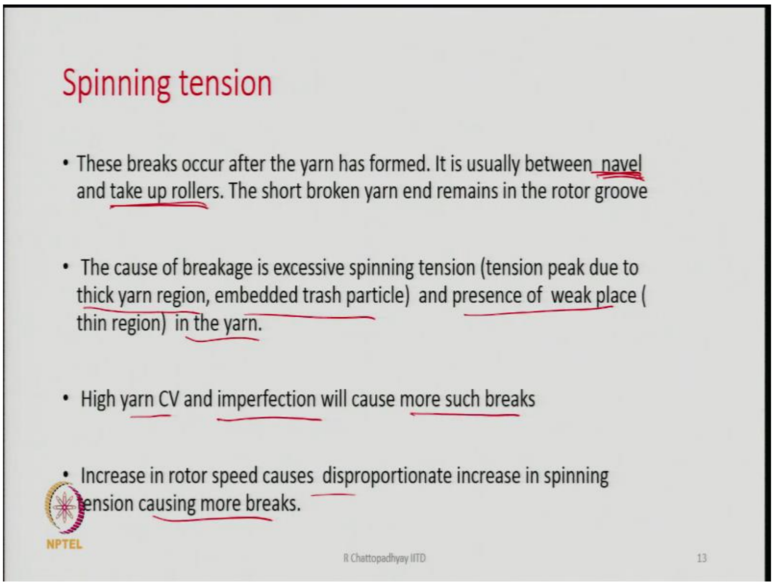

First, we discuss Spinning tension, we have already discussed about the spinning tension these breaks will occur after the yarn has been formed it is usually between navel and the take up rollers, the short broken yarn end remains in the rotor groove. So, spinning tension within the rotor the yarn may break and between the navel and the take up roller if the yarn breaks where the tension is actually maximum; then part of the yarn will be stay back in the rotor.

So, if we open the rotor housing a rotor box and check what is there in the rotor, we will see twisted yarn is lying there. That basically means that the breakage has occurred between the navel or the nozzle take up nozzle and the take up roller where the actual tension is maximum.

So, sometime the yarn may break there, if you breaks there part of it goes forward and it goes into the you know on the package and the rest part of the yarn will be sucked and it will be stay in the rotor groove. So, this will give an indication that actually the breakage is happening between the navel and the take up roller. The cause of breakage is excessive spinning tension, tension peak due to thick yarn region, embedded trash particles and presence of weak place in the yarn.

So, such kind of breakage could be because of excessive tension or sometime that could be tension peak; the average tension may be all right, but tension peak may be you know may appear because of thick yarn region or there could be big trash particles in the rotor, suddenly mass may increase and due to that the peak may come.

The other thing is the weak places that especially thin regions in the yarn in that case also the spinning tension will be overcoming, the strength of the yarn in the zone that is between navel and take up roller and the yarn will break. High yarn CV and imperfection will cause more such breaks, because High CV and imperfection basically means more weak place in the yarn and therefore, we can expect more breakages.

Increase in rotor speed causes disproportionate increase in spinning tension causing more breaks. So, we have to be very careful about the selection of rotor speed or if we want to increase the speed we have to see, what is the implication of the increase in rotor speed on end breakage rate? Finally, even 5%, 10% increase in rotor speed may cause a huge increase in end breakage rate.

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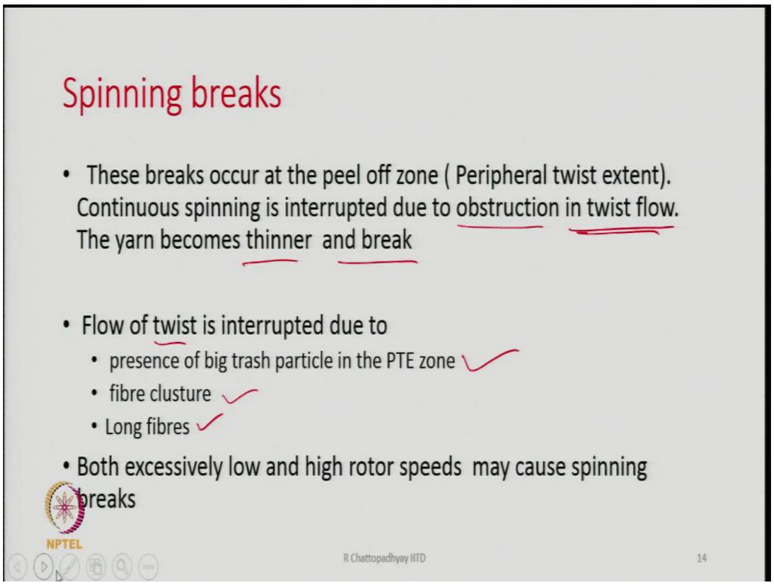

Spinning breaks, these breaks occurs at the peel-off zone, so where actually the twist is flowing a bit into a rotor groove. So, in the peel-off zone or the PTE zone the band of fibre is partially twisted, not fully twisted. So, there is a if the PTE zone the fibres are partially twisted. So, twist is flowing from the yarn part of the band of fibre is twisted and the rest of the band is untwisted is just a parallel you know band of fibres.

Now spinning breaks occur in the peel-off zone continuous spinning is interrupted to obstruction due to obstruction of twist flow. So, the twist flow is the obstruction then this is going to happen. The yarn becomes gradually thinner and the break, that is the spinning will discontinue; twist is not flowing properly and you are pulling the yarn out at the same time. So, yarn will be thinner and finally it will break.

And how the twist flow is interrupted? Because, of presence of big trash particles in the PTE zone and presence of fibre clusters. So, a bundle of fibre may be not open properly and entering the rotor and presence of even long fibres can result within this and crumbled fibres. So, these are the many facts which can affect twist flow.

Both excessively low and high rotors speed may cause spinning breaks, if the spinning speed is low the tension in the yarn will be less and the flow of twist flow of torque into the band of fibre also will be less. See how much torque can flow through a twisted yarn depends upon the what is the level of tension in the yarn.

So, if we do not run the rotor at a high at a reasonable speed then also we will find that there is lot of difficulty in spinning the yarn, we are not in a position to spin the yarn. Similarly too high speed also will call lot of breakages because the spinning tension going extremely high and breaks will be there.

So, low too low speed is bad too high speed is also bad both will cause interaction in the spinning process and the reason of interruptions are different. So, there is an optimum range of speed in which we have to work. If we go below that, we will suffer in terms of productivity, breakage will be more; if we go too high also breakage will be very high.

For a given fibre and the it is quality the trash which is there the kind of twist we are using keeping on so many parameters there is a range of speeds in which we will be able to work and going beyond that we will you know we will we will make the spinning process very difficult.

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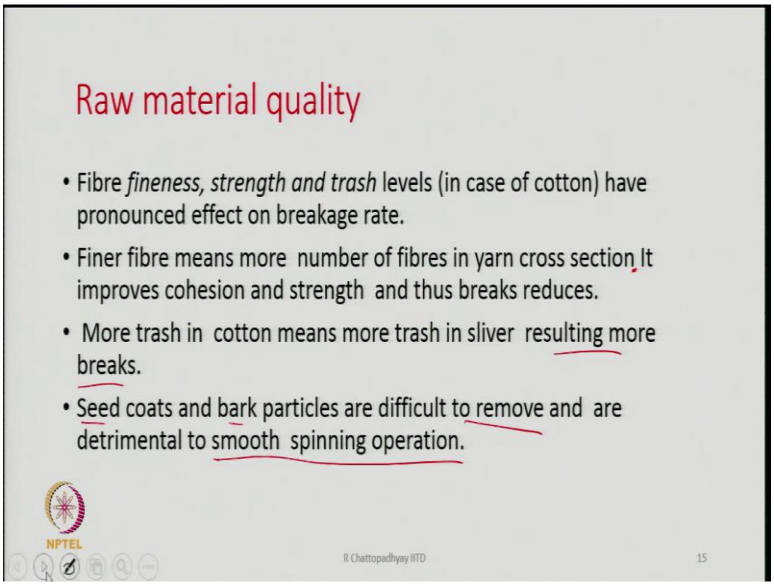

Raw material quality it is the natural that the fibres are fine, fine fibres, strong fibres, low level of trash they are always good especially for cotton and they have a pronounced effect on breakage rate. Finer fibres means, more number of fibres in the yarn cross section.

It improves cohesion and strength and thus breaks will always reduce if we go for fine fibres. More trash in the cotton means more trash in sliver resulting more breakages, more trash in sliver means more trash in the rotor also. Finally, rotor will be getting choked very quickly because of presence of too much of trash in the sliver.

And hence the cleaner sliver is always required and there are certain norms how much clean this sliver should be and that also depends on the count of a yarn that we want to produce. But those kind of industrial norms are there. Seed coats and bark particles are difficult to remove and are detrimental to smooth spinning process. So, these are very bad for the rotor spinning.

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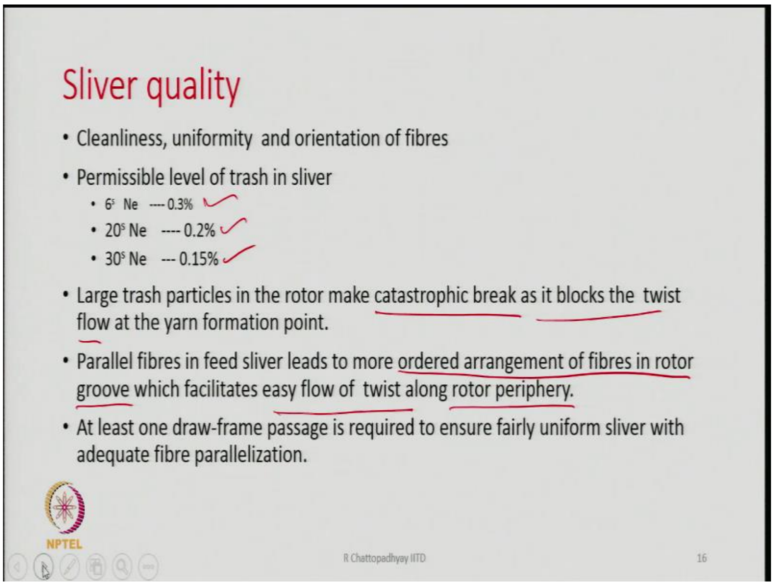

Then sliver quality basically 2 aspects are there one is cleanliness of the fibre the other one is parallelization and orientation of fibres. So, from the cleanness point of view the level of trash permissible is stated here these are basically kind of industry norm and the other thing is the large trash particles in the rotor can create catastrophic break as it blocks the twist flow, that is very very dangerous if it is you know large size trash particles are present in the sliver.

So; that means, the size of the trash particle also will matter. The other thing is parallelization of fibres parallel fibres in fluid sliver lead to more ordered arrangement of fibres in the rotor groove. Which will facilitate easy flow of twist along the rotor periphery, this is the reason why we say that in the case of rotor spinning we have to give at least one passage to the sliver card sliver.

Because we need to make the fibres parallel straight and parallel, we want to orient them. The reason is that though most of this orientation will be disturbed by the time the fibres arrive in the rotor groove, but still part of it will be still maintained. So, there is a good correlation between parallelization of fibres in the sliver and parallelization of fibres in the rotor groove it has been shown there is some correlation and because of this parallelization the end breakage rate actually goes down.

When you feed you know at least one draw from passage given sliver into the rotor into in to the rotor spinning vis a card sliver being fed to the rotor spinning machine. So, just to avoid too many breakages we have to give at least one passage of drawing, 2 passage also could be better but at least 1 passage is always beneficial.

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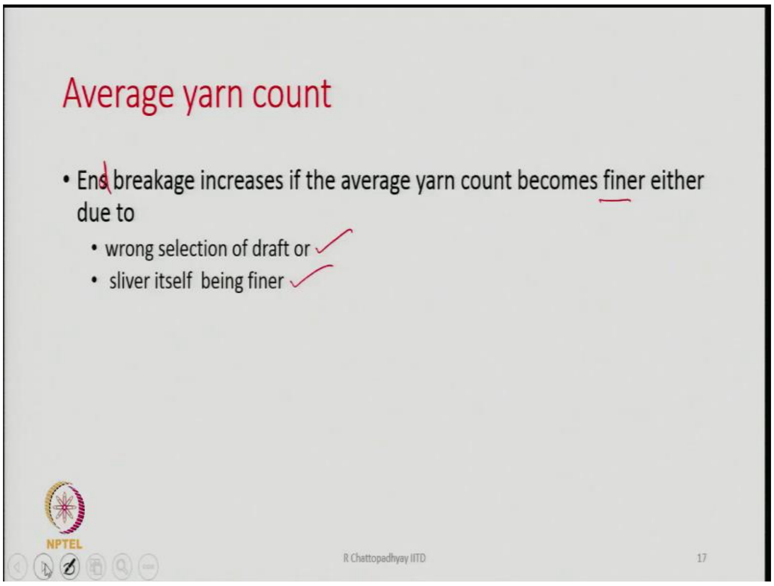

Average yarn count end breakage end breakage increases, if the average yarn count becomes finer either due to wrong selection of draft or sliver itself being finer this, may happen in the industrial situations or sometime the draft may go wrong or the sliver itself has become finer.

Due to some reason during the you know manufacturing of the sliver itself maybe, because maybe something has gone wrong in the draft selection on the carding machine or draft selection on the draw frame. So, there are many reasons why time sliver becomes average sliver count become finer. In that case the yarn will be finer and the you have a bit tension and the strength imbalances in the yarn the breakages could be there.

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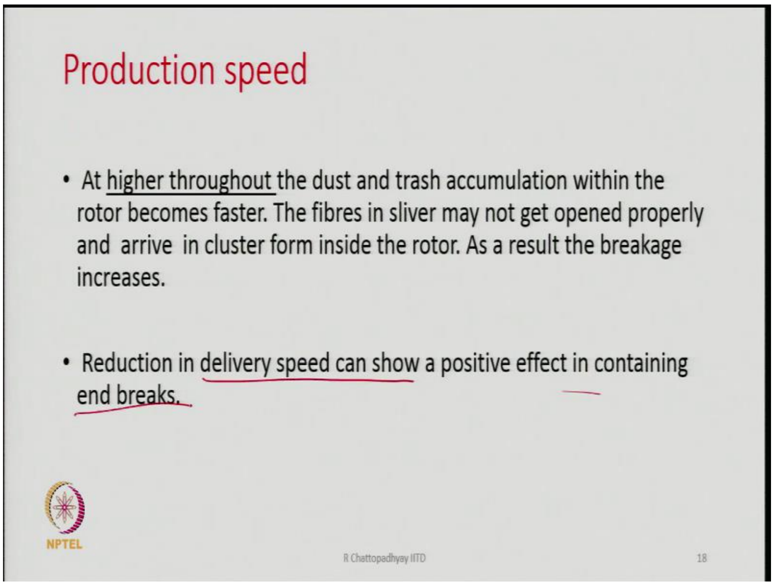

Production speed; higher throughput, the dust and trash accumulation also will be very fast within the rotor, if I want to increase predictive productivity that basically means I have to feed more fibres per unit time into the rotor groove. As I feed more fibres, I also feed more trash particles within the case of cotton and therefore, the rotor groove will get clogged very soon with the trash particles.

Similarly, if I want to produce a very thicker count very coarse count yarn, now coarse count yarn means I am be feeding more fibres because I have to draft will be less and it will also know lot of dust also be fed simultaneously. So, when you try to produce coarse count yarn, my throughput rate in terms of you know gram of fibre fed per unit time is going to be more and therefore more dust is also being fed and you can expect quick accumulation of dust within the rotor.

And when the dust accumulation goes beyond a certain limit it will cause a break. So, reduce the dust accumulation thickness, thickness of the dust accumulation; what we do? we go for bigger diameter rotor in the case of coarser count when we are spinning. So, when we try to spin coarse count yarns usually rotor diameter that we choose is much bigger in comparison to when we try to spin final count yarn which was smaller diameter rotor.

When you go for coarse count yarn, we go for big diameter rotors. The reason is because of this you know dust problem, coarse count quick and fitting of fibre as per unit time more material is going inside more dust is also going inside. So, dust accumulation rate is very faster and once it goes beyond a certain thickness it will end up a breakage. So, if we spread out the dust over a larger circumference the rate of increase of thickness of the accumulated dust will be slower.

So, the breakage frequency will go down. Therefore, reduction in delivery speed can show a positive effect containing end breaks. So, in case the breaks are too much we reduce production speed that has a positive effect.

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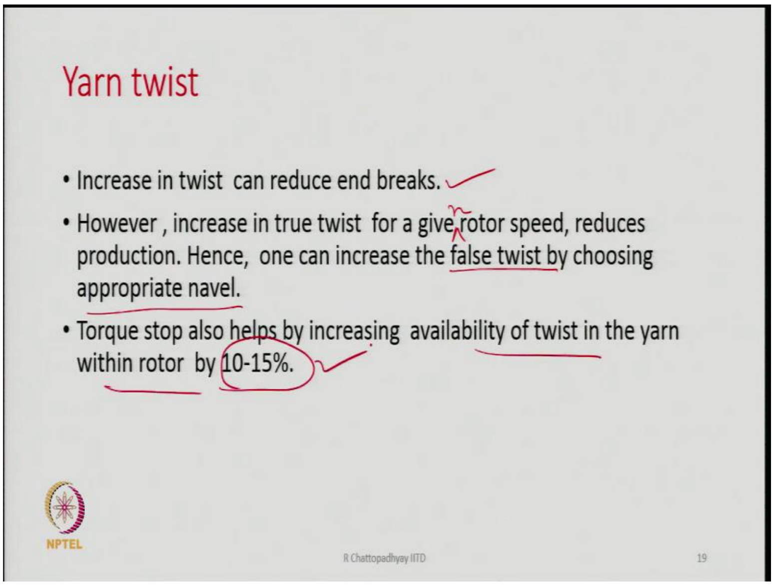

Yarn twist increase in twist can reduce end breakage; however, increase in true twist for a given rotor speed reduces production. Hence one can increase the false twist by choosing appropriate navel. So, that is what we generally try to see if we increase the twist strain may increase a bit and therefore, the you know the because they may go down.

But if we try to increase twist; obviously, the production rate will suffer. Generally, twist is adjusted by reducing the delivery speed not by increasing the rotor speed, because the end breakage rate is very sensitive to the rotor speed or in the case of ring spinning to a spindle speed.

So, generally twist adjustment is done by changing the delivery roller speed, in the case of roller speed the take up roller speed you can say. So, that speed will reduce and take up roller speed means basically means our production rate is the less. So, the way out is that I generate more false twist and how do I generate more false twist? By having proper navel.

So, you will find that we have already discussed navels are available with different types of grooves and that can help in generating false twist and false twist means in the yarn the twist will go up. So, the yarn will be stronger and therefore we may encounter less breaks this is the reason that we go for generating more false twist.

Torque stop is also is has a similar you know effect; torque stop helps in increasing the availability of twist in the yarn within the rotor by 10 to 15%; that is we are not going to increase the true twist. That is why we use torque stop the very purpose of using torque stop is that you restrict the flow of twist, ultimately the twist in the yarn, yarn is going to increase because of the torque stop.

So, torque stop as well as the navel both of them have a positive influence in generating in making more twist available, in the yarn within the rotor. Whereas, the twist in the package is not going to change that will be one same that will be decided as per the normal you know the twist relationship that is rotor speed and delivery speed ratio, that will not change.

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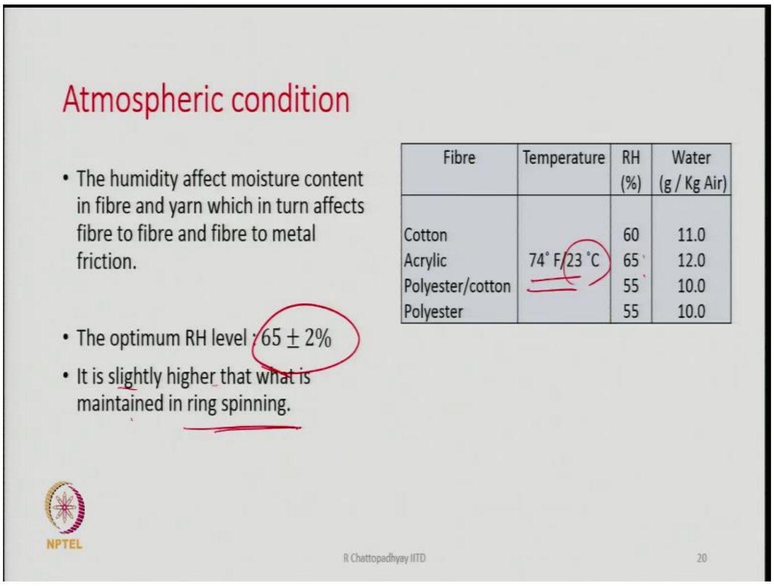

Atmospheric conditions is also important, the different types of atmospheric conditions are stated here temperatures should be around 23 °C. If we can maintain it is good and these are the typical relative humidity, we should have for different types of fibre cotton we need 60% relative humidity.

The humidity effect moisture content in fibre and yarn which in turn affects fibre to fibre and fibre to metal friction and thereby it can affect end breakage the optimum is this 65±2%. If the humidity is too dry for cotton there will be lot of breakages, because question will not be there cotton absorb moistures and due to that the cohesion is better between cotton fibres.

Otherwise, the cohesion between cotton fibres will be low if it is kept in a dry atmosphere. Whereas, acrylic, polyester this thing will not going to be affected because they do not absorb any moisture. So, there the role of moisture is different that is to avoid the static electricity generation, for cotton we make the fibres absorb some moisture so that there is some cohesion between the fibres and therefore the breakage rate can be brought down.

It is slightly higher than what is maintained in ring spinning, with that we close today's session. So, we have learnt about the spinning tensions, why the tension varies, the tension is different from starting from the rotor groove to the package, the maximum tension is occurring between the navel and the take up roller, winding tension is much less than the tension prior to the take up roller.

At the same time, you have to remember that the breakage rate is highly influenced by the spinning tension and also on the quality of sliver, fibre that we use and that means it depends upon the kind of process that we select to prepare the sliver, the level of trash in it and the relative humidity.

The other thing is that we can also bring down the end breakage rate by making more twist available in the yarn arm by having either a navel of appropriate type, we generate more false twist or we can use a torque stop. There is a various means by which we have to you know make sure that the process runs at the optimum level ok. With that we close.

Thank you.